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Costs of Producing Grapefruit in California and Florida, 1988/89

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Abstract. *Cost-of-production data were collected in March 1990 for grapefruit in Florida and California, the leading grapefruit-producing States, as part of the U.S. Department of Agriculture's Farm Costs and Returns Survey. For the 1988/89 season, cash receipts per acre minus both variable and fixed cash expenses and capital replacement were positive for grapefruit in both States. Total economic costs per box of grapefruit were estimated to be $6.82 in California (64-pound box) and $5.00 in Florida (85-pound box). Returns above full economic costs were negative in California, but positive in Florida. Return to management was $413 per acre in Florida and –$142 per acre in California.*

In March 1990, cost-of-production information for the Nation's grapefruit crop was collected for the first time as part of the U.S. Department of Agriculture's Farm Costs and Returns Survey (FCRS). Reliable farm cost-of-production information contributes to better decision-making and planning in the citrus industry. Growers, prospective growers, agricultural lenders, and others concerned with the grapefruit industry should find the information valuable for estimating the financial requirements of producing and maintaining grapefruit groves. FCRS data can be useful for making production decisions, such as selection among alternative crops. The long-term competitive position and the likely future adjustments of the U.S. grapefruit industry in an expanding global market can also be better evaluated. Cost-of-production (COP) estimates aid industry and government policymakers in making decisions with regard to international trade and domestic programs and regulations that affect the U.S. grapefruit industry.

The FCRS is conducted annually by the Economic Research Service (ERS) and the National Agricultural Statistics Service (NASS). It represents a random sample of all U.S. farms and includes a selected set of crops on which detailed costs of production are collected each year. In March 1990, COP questionnaires were enumerated for a sample of grapefruit grove operators in the two major U.S. grapefruit-producing States, Florida and California. This report presents the State-level COP data for grapefruit, estimated from information collected on the FCRS and other secondary sources.

For the 1988/89 crop year, 2.8 million tons of grapefruit, worth $418 million, were produced in the United States on over 150,000 acres. Florida accounted for 82 percent of the total U.S. grapefruit crop that season, while California accounted for 9 percent. Arizona and Texas, the only other States with significant commercial production, together accounted for the remaining 9 percent of the U.S. total.

Over 56 percent of the Florida grapefruit crop is used for processing, mostly into frozen concentrated grapefruit juice. In contrast, grapefruit in California is targeted for the fresh market, both domestic and foreign. In 1988/89, 69 percent of the California grapefruit crop went for fresh use, representing over 99 percent of the total value of grapefruit production in the State.

Grapefruit Farm Characteristics

In Florida, 40 useable questionnaires were received from a sample of 120 grapefruit operations. These operations averaged 510 acres of grapefruit (table 1). Eighty-six percent of the grapefruit acres had trees of bearing age. The remaining 14 percent of grapefruit acres were planted either in 1989 or before, but not yet bearing in 1988/89. About 20 percent of the grapefruit operations surveyed in Florida had less than 50 acres of grapefruit, and accounted for less than 1 percent of the grapefruit acreage. The remaining 80 percent of the operations, with 50 or more acres of grapefruit, accounted for over 90 percent of the grapefruit acreage.

In California, 39 useable questionnaires were received from a sample of 161 grapefruit operations. These operations averaged 22.5 acres of grapefruit (table 1). Ninety-six percent of the grapefruit acres had trees of bearing age, with the remaining 4 percent having trees not yet in production in 1988/89. Over 90 percent of the grapefruit operations surveyed in California had fewer than 50 acres of grapefruit and accounted for 48 percent of the grapefruit acreage.

Method of Analysis

The estimated costs of producing grapefruit are presented as an enterprise budget on a per-acre unit basis. The budget separates cost and return measures into three categories: cash receipts, cash expenses, and economic (full-ownership) costs. Although estimating procedures differ, the categories are consistent with budgets prepared for other commodities by the Economic Research Service (ERS).

The budgets reported here are calculated on a per-acre basis where the grapefruit acres include the mix of bearing and non-bearing trees that existed on the FCRS sample of grapefruit operations. Therefore, the per-acre COP estimates include costs of both bearing and non-bearing trees. Sales revenues from fruit are spread over the total acres, both bearing and non-bearing. To the extent that the mix of bearing and non-bearing acres in 1988/89 represents the long-term mix of trees needed to maintain productive groves, the estimated cost for 1988/89 production would represent longrun grapefruit costs of production.

Cash Receipts

Cash receipts per acre are calculated by multiplying the total boxes produced per total acres of both bearing and non-bearing trees by the price per box. Yields in boxes per acre are calculated from survey data. These yields will differ from those reported by NASS because NASS yields are for bearing acres only. Yields are expressed as the number of 85-pound boxes in Florida and 64-pound boxes in California. The all-grapefruit price (fresh and processing) per box for the 1988/89 crop-year is that at the packinghouse door and reported by NASS.

Variable Cash Expenses

Two types of cash expenses, variable and fixed, are reported in this study. Variable cash expenses are separated into nine categories: (1) nursery stock, trees, and seed, (2) fertilizer, (3) chemical and biological pest control, (4) custom operations and equipment rental, (5) fuel, lubrication, and electricity, (6) repairs, (7) hired labor, (8) purchased irrigation water, and (9) miscellaneous expenses. Crop insurance expenses were excluded from the above categories because insurance claims were excluded from cash receipts. This treatment is consistent with procedures used for other crops in the ERS COP program.

Table 1–Size distribution of grapefruit operations in Florida and California, Farm Costs and Returns Survey, 1988/89

Item	Florida		California	
	Farms	Acres	Farms	Acres
		Number		
Farms surveyed:	40	--	39	--
Average total acres/farm	--	4,296.7	--	111.4
Average grapefruit acres/farm	--	510.0	--	22.5
Average acres planted, 1989	--	11.7	--	.2
Average other non-bearing acres	--	32.4	--	.8
Average bearing acres	--	438.9	--	21.1
		Percent		
Acres/operation:				
Fewer than 10	5.0	0	55.5	7.3
10 to 29.9	9.9	.3	21.4	14.9
30 to 49.9	5.0	.4	13.6	25.8
50 to 99.9	17.4	2.4	5.9	18.5
100 to 249.9	22.5	7.0	3.6	33.5
250 to 499.9	20.1	14.1	0	0
500 or more	20.1	75.7	0	0
Total	100.0	100.0	100.0	100.0

— = Not applicable.

Survey respondents reported the dollar value of expenses for all variable cash expense categories. For fertilizer, chemical and biological pest control, and custom operations, operators reported the dollar value specifically associated with the grapefruit enterprise. For nursery stock, trees, seed, hired labor, purchased irrigation water, fuel, lubrication, and electricity, the operator was asked to report the dollar value of expenses for the entire farm operation and then separate the percentage that was used for grapefruit. For the miscellaneous expenses and interest on operating loans, the operator reported total expenses for the entire operation. A percentage was then allocated to grapefruit based on the grapefruit proportion of the operation's total sales.

Fertilizer includes the cost of all fertilizer, lime, soil conditioners, micronutrients, and secondary nutrients applied to the grapefruit crop. Also included is the cost of custom application, if it was impossible for the operator to separate application and material cost. When they could be separated, custom application of fertilizer was included with the custom operations and equipment rental category.

Chemicals include the total cost of all chemicals applied to grapefruit, such as insecticides, herbicides, fungicides, surfactants, and wetting agents. Like fertilizer, application costs were included only if custom application costs could not be separated from the material cost. Otherwise, custom application costs were included in the custom operations and equipment rental category.

Fuel, lubrication, and electricity include the dollars spent for all fuels, motor oils, and electricity for irrigation. Electricity for non-irrigation purposes was included in general grove overhead.

Repairs include the dollars spent for repairs and parts for motor vehicles, machinery, equipment, irrigation, and frost protection. This would include overhauls, tuneups, tubes, tires, and other repairs.

Hired labor includes total cash wages and cash bonuses paid to all hired workers (including any cash wages paid to family members). Cash wages paid to the operator are excluded. Hired labor also includes any contract labor where workers are paid by a cooperative, crew leader, contractor, buyer, processor, or other person having an oral or written agreement with the operator. Cash expenses for paid labor benefits such as life or health insurance, pension or retirement plans, workers' compensation, employer's share of Social Security, and unemployment taxes are included in the hired labor expense.

Purchased irrigation water includes the dollars spent for irrigation water and drainage assessments and fees. Also included are pumping and overhead costs for private association water.

Interest on operating loans includes both interest and service fees. The total dollar amount for the operation was reported by the operator, then allocated to grapefruit based on the proportion of sales from grapefruit.

Miscellaneous expenses include accessories for motor vehicles and machinery, office equipment purchases, marketing containers, and transportation of items to market or between farms.

Fixed Cash Expenses

Fixed cash expenses are separated into three categories: real estate and property taxes, interest on real estate debt, and general grove overhead.

Interest on real estate debt includes both interest and service fees secured by farmland, buildings, and other real estate debt. This includes the operator's dwelling if located on the operation.

General grove overhead is a composite of utilities such as non-irrigation electricity, telephone, and water; all insurance (other than crop insurance), such as the farm share on motor vehicle liability and blanket insurance policies; registration and license fees for motor vehicles; and general business expenses, such as accounting fees, legal fees, travel, memberships, farm management services, soil testing, magazines, office supplies, co-op fees, and advertising. Purchases of farm supplies and hand tools, and farm and shop power equipment are also included in general grove overhead. Farm and land improvement and maintenance such as fencing, operator's dwelling, hired labor and tenant dwellings, and other farm buildings are included in general grove overhead.

Capital Replacement

Nonland capital was divided into five categories: vehicles, tractors, grove equipment, irrigation pumps and distribution systems, and frost protection equipment. Trees were not depreciated directly, as replacement costs were included in the costs for non-bearing acres on the surveyed operations. Information was col-

lected on the number of vehicles in six categories (pick-ups, single-axle trucks, tandem-axle trucks, semi trucks, buses, and vans); the number of tractors in six size categories (less than 30 horsepower [hp], 30-39 hp, 40-59 hp, 60-109 hp, 110-169 hp, and 170 hp and above); and the items of each type of equipment used for grapefruit production. For each vehicle and tractor category and equipment type, the operator was asked to report the percent of total use for grapefruit and the average age when items in each category were usually replaced. Based on this information, annual capital replacement was estimated using two engineering equations, one for vehicles and tractors and one for equipment as follows:

Vehicles and tractors,

$$Captrac=\sum_i^n \frac{(NUM_i)\left(\frac{PCT_i}{100}\right)(I_i-(0.68)I_i(.92^{UL_i}))}{UL_i}$$

Equipment,

$$Capequip=\sum_i^m \frac{(NUM_i)\left(\frac{PCT_i}{100}\right)(I_i-(0.6)I_i(.885^{UL_i}))}{UL_i}$$

where:

Captrac =	annual capital replacement for tractors and vehicles,
Capequip =	annual capital replacement for grove equipment,
I =	purchase price for new vehicles, tractors, or equipment,
NUM =	the number of vehicles, tractors, or equipment in each category,
PCT =	the percent of total use for grapefruit,
UL =	the usual age in years when the item is replaced,
n =	the number of vehicle or tractor categories, and
m =	the number of equipment types used for grapefruit.

The values are engineering coefficients commonly used in farm management studies.[1]

This procedure for computing capital replacement varied from the usual procedures where operators separately reported each vehicle, tractor, and equipment item.

Capital replacement costs for frost protection (excluding irrigation systems), mostly reflecting wind machines and grove heaters, were calculated using straight-line depreciation assuming zero salvage value combined with information reported by the operator on the percentage of time the equipment is used for grapefruit, and age when the equipment is usually replaced. Costs for installing electric-, gasoline-, diesel-, and propane-powered wind machines were obtained from equipment manufacturers and secondary sources.

For irrigation systems, capital replacement costs were calculated for pumps and distribution systems only. Wells were not depreciated, but were valued at drilling cost and included with land value. In many cases, wells transfer with land and would, therefore, enhance land values. Straight-line depreciation was assumed using zero salvage value with a 12-year useful life for pumps and 15 years for the distribution system. Drilling costs, pumps, and distribution costs were obtained from dealers and contractors in each State.

Full Economic Costs

Estimated economic or full-ownership costs indicate the average longrun cost that must be recovered annually from farm revenue to keep land in grapefruit production and maintain the long-term viability of the enterprise. For full economic costs, a return is calculated for operating capital, and other nonland capital, unpaid labor, and land. This total is added to variable cash expenses, general farm overhead, real estate and property taxes, and capital replacement. Any residual cash receipts, after subtracting full economic costs, are assumed to be a return to management and risk.

A rate of return to land and nonland capital is computed by using a 10-year total return to production assets in the agricultural sector (previous 10 years) minus the value of the operator's labor each year and divided by the total market value of agricultural production assets. Average market value of nonland capital, including tractors, vehicles, and equipment, and the value of land reported by the survey respondents is multiplied by this 10-year average return. Earnings from inflation (capital gains or losses from depreciation) are not included in the grapefruit enterprise budget.

Estimates of Grapefruit Production Costs

The budgets reported here approximate the long-term costs and returns for maintaining a grapefruit grove over time, reflecting the mix of new, non-bearing, and commercially producing trees in the FCRS. If the mix of bearing and non-bearing acres in the sample of

[1]Vernon R. Eidman and Michael D. Boehlje, *Farm Management*, John Wiley and Sons, New York, 1983.

operators represented the long-term mix needed to maintain productive groves, then estimated costs for 1988/89 production would represent longrun costs of production.

Cash Receipts

Cash receipts per acre were calculated by multiplying the 1988/89 season average price received for all grapefruit reported by NASS by the average yield per acre reported on the survey. Average yield for total acreage (including both bearing and non-bearing acres) was 357 boxes in California (64-pound boxes) and 381 boxes in Florida (85-pound boxes).

Gross value per acre was estimated at $2,293 in California and $2,318 in Florida (table 2). These values are for the 1988/89 season and do not reflect the major Florida freeze in late December 1989.

Variable Cash Expenses

Total variable costs per acre were estimated at $1,590 for California and $1,442 for Florida (table 2). Hired labor was the single largest cash expense in both California and Florida, representing 43 and 53 percent of the total variable cash expenses. This cost includes picking and hauling, whether or not it was paid directly to cooperatives, workers, crew leaders, contractors, or others.

Fertilizers and chemicals, including biological pest control, also were major costs in both California and Florida, but especially Florida. Expenses per acre for fertilizer and chemicals were over 2-1/2 times higher in Florida than in California.

Variable cash expenses per acre for purchased irrigation water, custom operations and rental, fuel, lubrication, electricity, and miscellaneous expenses were all much higher in California than in Florida.

Fixed Cash Expenses

Fixed expenses totaled $318 per acre in California and $350 in Florida (table 2). General grove overhead accounted for 39 percent of the total in California and 38 percent in Florida. Interest on real estate debt was about the same in California and Florida. Real estate and property taxes per acre were estimated at $45 in California and $64 in Florida.

Capital Replacement

Total capital replacement costs were estimated at $136 per acre in California and $62 in Florida (table 2). Capital replacement costs per acre for vehicles, tractors, and grove equipment were about three times higher in California than in Florida, reflecting more owned machinery on California groves. Capital replacement costs in irrigation distribution systems were about equal in both States. Wind machines for frost protection are almost obsolete in Florida but are still used extensively in California.

Pumps and irrigation systems are a major investment for grapefruit production. If wells were used as a source of irrigation water for grapefruit groves, information was asked on the number of wells used, average depth, pumping lift, and casing diameter. Wells accounted for an estimated 20 percent of the water used on grapefruit in California and 52 percent in Florida. The smaller proportion of water from wells in California compared with Florida reflects the relative importance of surface water from irrigation districts.

The average well in Florida was 628 feet deep, with a 40-foot pumping lift, and an 8-inch casing diameter. In contrast, wells in California averaged 510 feet deep with a 256-foot pumping lift, and a 12-inch casing diameter. The drilling costs per well were calculated using the following equations based on secondary information from drilling companies in both States:

California,

$$\$17{,}385 = \$300 + \$33.50 \times (510\ [\text{average depth}]),$$

Florida,

$$\$14{,}502 = \$1{,}000 + \$21.50 \times (628\ [\text{average depth}]).$$

The higher constant term in Florida ($1,000) than in California ($300) reflects primarily higher costs for well-drilling permits. The lower drilling cost per foot in Florida is mostly due to the 8- rather than 12-inch casing diameter. Secondary sources indicated that the costs of the motor and pump for the well, including installation, were about equal to the drilling costs in both States.

The most common irrigation system in Florida was micro-sprinklers. This type of water distribution system was used on about 65 percent of the grapefruit groves there (table 3). Gravity flow irrigation systems accounted for another 20 percent in Florida while drip irrigation (6 percent) and solid set sprinklers, either over or under the trees (8 percent), represented a relatively small portion of the irrigation systems. In contrast, only 19 percent of the operations in California reported using the micro-sprinkler irrigation system, with 20 percent reporting solid set sprinklers placed under the

Table 2–Grapefruit cash receipts and production costs, California and Florida, 1988/89

Budget item	California	Florida
	Boxes/acre	
Yield 1/	357.20	381.31
	Dollars/acre	
Price (NASS, per box, 1988/89)	6.42	6.08
Cash receipts	2,293.22	2,318.36
Variable cash expenses:		
Nursery stock, trees, and seed	23.01	33.77
Fertilizer	81.17	157.34
Chemicals and biological pest control	71.76	240.74
Custom operations and rental	156.08	16.75
Fuel, lube, and electricity	145.84	36.44
Repairs	70.32	71.86
Hired labor	685.77	770.03
Purchased irrigation water	176.27	4.04
Interest on operating loans	5.15	22.76
Miscellaneous	174.17	88.49
Total variable cash expenses	1,589.54	1,442.22
Fixed cash expenses:		
Real estate and property tax	45.11	64.41
Interest on real estate	149.65	152.24
General grove overhead	123.05	133.57
Total fixed expenses	317.81	350.22
Total cash expenses	1,907.35	1,792.44
Capital replacement:		
Vehicles	29.72	7.41
Tractors	19.03	11.53
Equipment	11.42	2.45
Irrigation system		
Pumps	19.84	7.81
Distribution system	36.44	32.47
Wind machines (regular and power takeoff)	19.95	0
Total capital replacement	136.40	61.67
Cash receipts less cash expenses and capital replacement	249.47	464.25
Economic (full-ownership) costs:		
Total variable cash expenses less interest on operating loans	1,584.39	1,419.46
General grove overhead	123.05	133.57
Real estate and property tax	45.11	64.41
Capital replacement	136.39	61.67
Allocated returns to owned inputs:		
Return to operating capital	66.76	62.74
Return to other nonland capital	25.90	10.41
Return to land	379.67	146.12
Unpaid labor (at $5/hour)	73.61	6.88
Total economic costs:		
Per/acre	2,434.88	1,905.26
Per/box	6.82	5.00
Cents per pound	10.7	5.9
Returns to management and risk	-141.66	413.10

1/ Box weight: California, 64 pounds; Florida, 85 pounds. Yields are total production divided by total acres including both bearing and non-bearing acres. COP estimates include cost for both bearing and non-bearing acres on sample operations.

Table 3–Percent of grapefruit operations reporting irrigation systems, by type of system and State, 1988/89

System type	California	Florida
	Percent	
Pressure:		
Micro-sprinklers	18.6	64.7
Solid set sprinklers, under trees	20.2	2.6
Solid set sprinklers, over trees	0	5.0
Solid set drippers	1.2	0
Drip irrigation	24.2	5.8
Hand-moved sprinkler (drag line)	15.5	0
Big gun	0	1.4
Other	4.3	.3
Gravity flow:		
Flood or furrow	16.0	17.0
Gated pipe	0	0
Other	0	3.2
Total	100.0	100.0

trees, and about 16 percent reported gravity flow irrigation systems. Hand-moved sprinklers accounted for 16 percent of the systems reported in California while none were reported in Florida. Drip irrigation accounted for about 24 percent in California compared with 6 percent in Florida.

Investment for the irrigation systems was obtained from irrigation companies in both States. The investment per acre for micro-sprinklers and drip irrigation systems declines for larger installations up to 160 acres. For installations of 160 acres or more, investment per acre was estimated at $600 for micro-sprinklers and $450 for drip systems. These costs include all booster pumps, mainlines, tree line pipes, and sprinklers or drippers.

Capital replacement for pumps used in the well only, assuming zero salvage value and a 12-year useful life, was about $20 per acre in California and $8 in Florida. Capital replacement for the distribution systems, including booster pumps, was estimated at $36 in California and $32 in Florida.

The use of wind machines for frost protection was reported in California on about 60 percent of the operations, while none of the operations surveyed in Florida reported using any. For operations with wind machines, information was obtained on the survey as to whether the wind machine was tower-mounted or powered by a tractor power takeoff, the age when usually replaced, and the proportion of its total use for grapefruit. Capital replacement for wind machines ($20 per acre) was calculated with this information combined with secondary sources on the new cost for tower-mounted wind machines, powered by gas, propane, and diesel, and a tractor power takeoff.

Return Above Expenses

Cash receipts less variable and fixed cash expenses and capital replacement left a positive $249 per acre in California and $464 in Florida (table 2).

Full Economic Costs

Interest on operating loans and real estate debt was subtracted from the sum of total cash expenses and capital replacement. Allocated returns to owned inputs, including operating capital, other nonland capital, land and wells, and unpaid labor, were then added to provide an estimate of total economic costs per acre for producing grapefruit.

Returns to operating capital, other nonland capital, and land and wells were calculated by multiplying their average values by 2.8 percent, the 10-year average return. This 2.8-percent return was used in calculating full economic costs for all crops for which 1988/89 COP estimates were made. The return to land and wells was $146 per acre in Florida and $380 in California. The average value of land per acre was $13,320 ($13,560 with wells) in California and $5,125 ($5,220 with wells) in Florida. The estimated return per acre for operating and other nonland capital was $63 and $10 in Florida and $67 and $26 in California. Unpaid labor, valued at $5 per hour in both States, was estimated at $7 per acre in Florida and $74 in California, reflecting larger Florida operations that tended to spread available unpaid labor over more acres.

Total economic costs in Florida were $1,905 per acre or $5.00 per 85-pound box and $2,435 in California or $6.82 per 64-pound box. Subtracting the full economic cost from cash receipts left a positive return to management and risk for producing grapefruit of $413 per acre in Florida and a negative return of $142 per acre in California.

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